BRAZILIAN DELEGATION
COLUMBIA RIVER STUDY TOUR

COLUMBIA RIVER SYSTEM OVERVIEW

By

Jim Barton

Chief, Columbia Basin Water Management Division
U.S. Army Corps of Engineers Northwestern Division

Portland, Oregon
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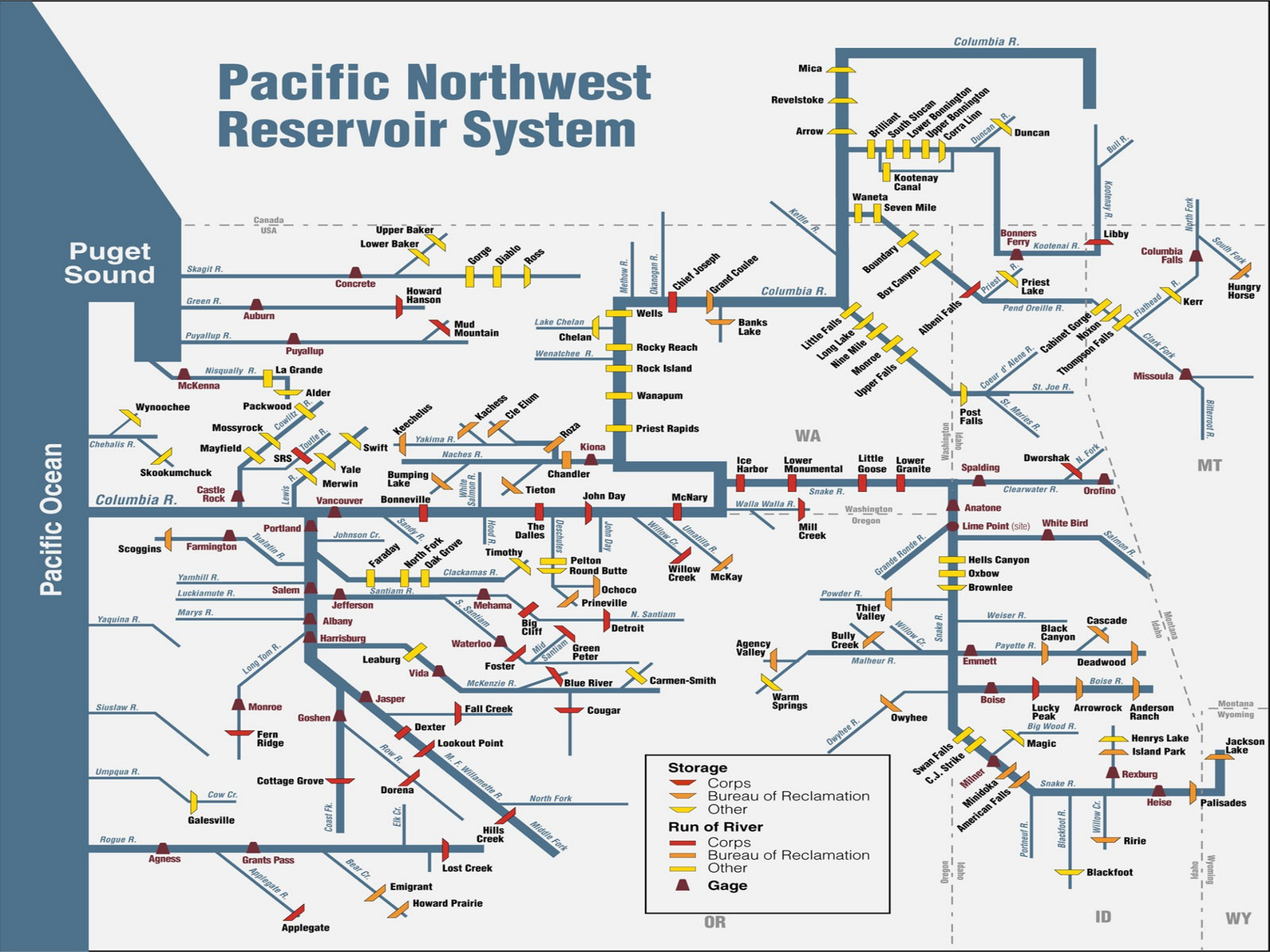
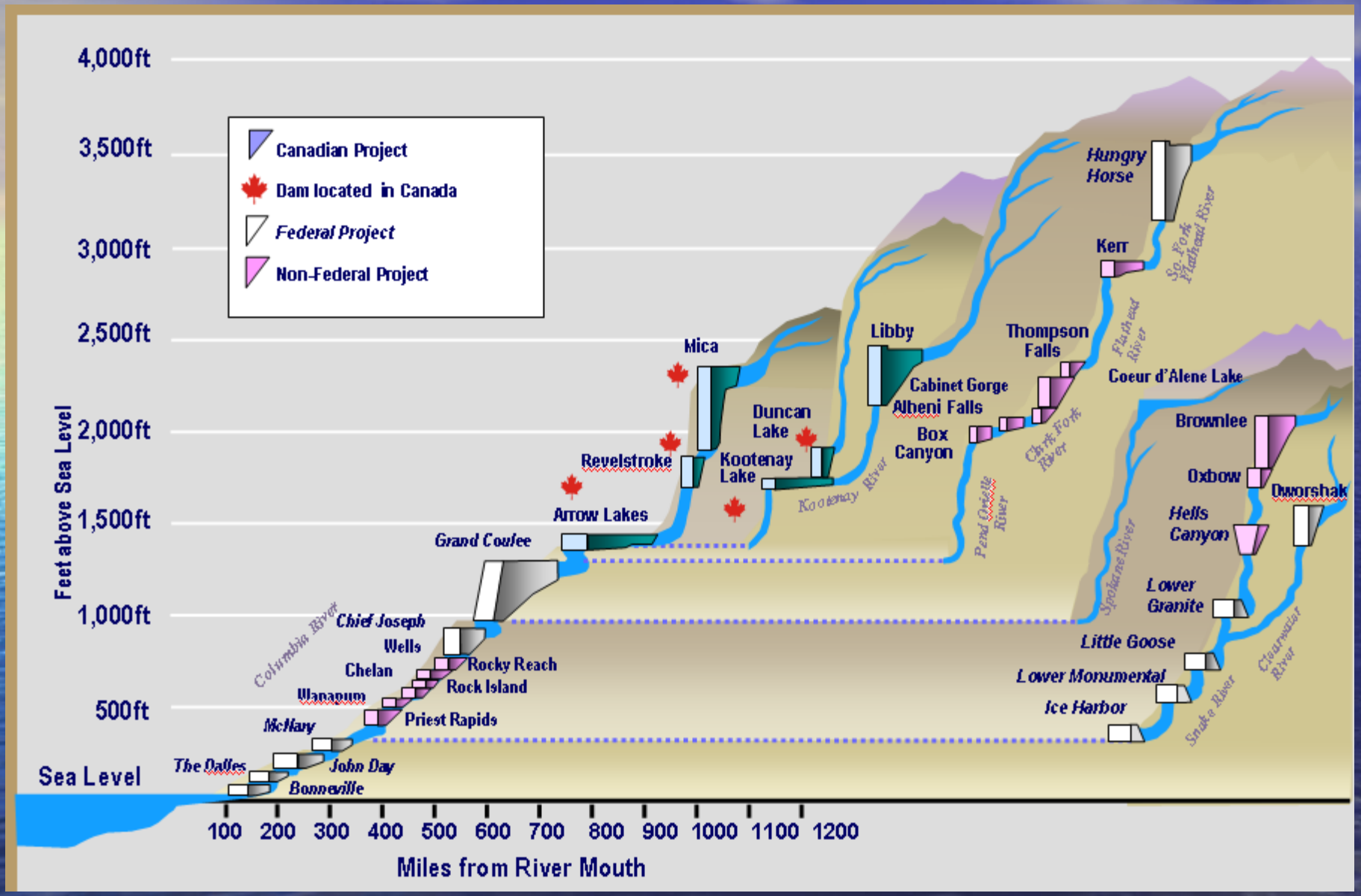
Presentation Topics

- Physical Characteristics
- Operational Considerations
- Coordination

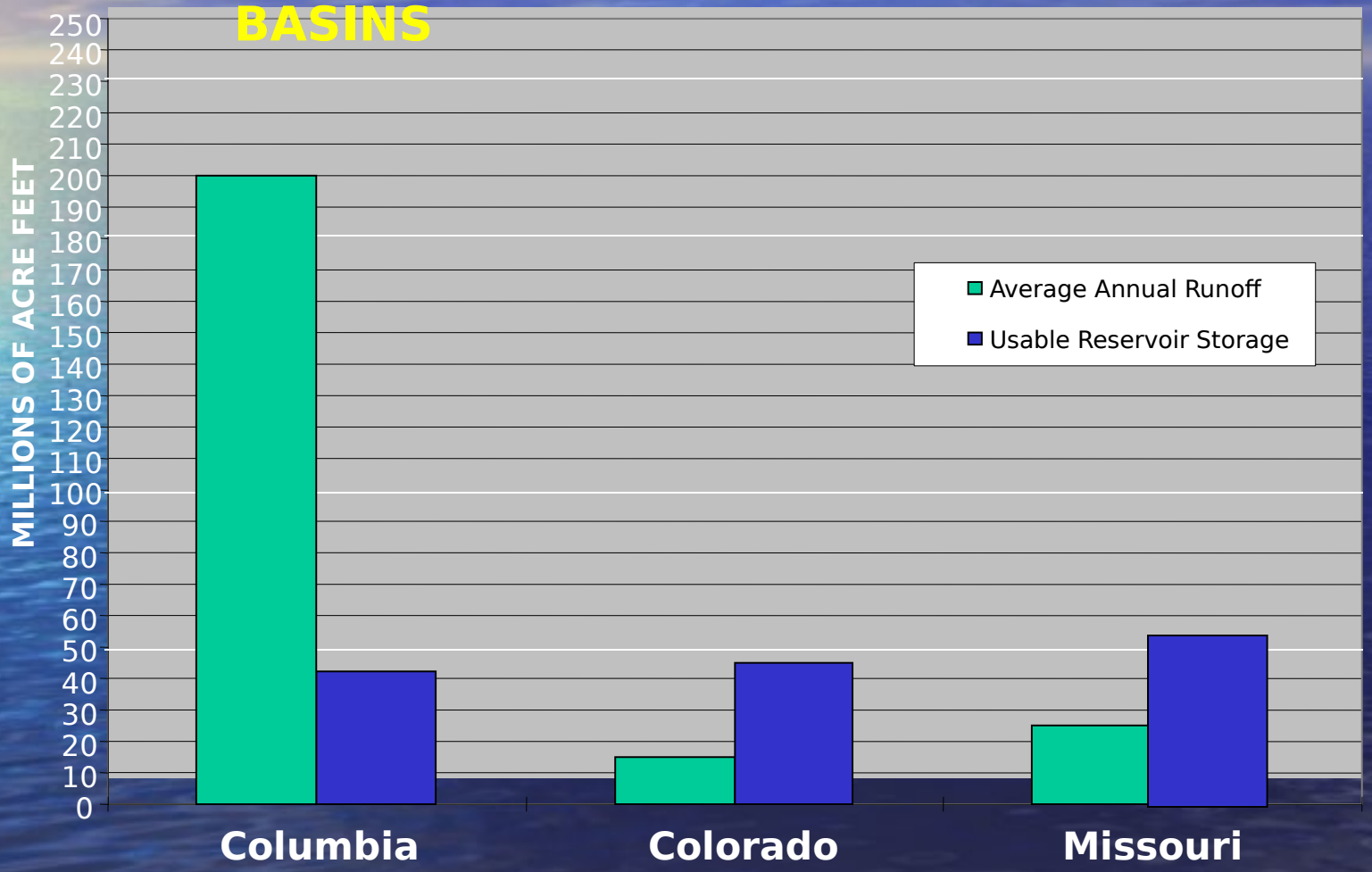
Columbia River Basin


Pacific Northwest
Reservoir System
Puget Sound
Pacific Ocean
Columbia R.
Canada
USA
Mica
Revelstoke
Arrow
Brilliant
South Slocan
Lower Bonnington
Upper Bonnington
Corra Linn
Duncan R.
Duncan
Kootenay Canal
Waneta
Seven Mile
Kootenay R.
Bull R.
Libby
Bonners Ferry
Kootenai R.
Kettle R.
Boundary
Box Canyon
Priest R.
Priest Lake
Albeni Falls
Pend Oreille R.
Columbia Falls
North Fork
South Fork
Hungry Horse
Flathead R.
Kerr
Cabinet Gorge
Noxon
Thompson Falls
Clark Fork
Missoula
Bitterroot R.
Little Falls
Long Lake
Nine Mile
Monroe
Upper Falls
Post Falls
Coeur d' Alene R.
St. Joe R.
St. Maries R.
Upper Baker
Lower Baker
Gorge
Diablo
Ross
Skagit R.
Concrete
Howard Hanson
Green R.
Auburn
Mud Mountain
Puyallup R.
Puyallup
Methow R.
Okanogan R.
Chief Joseph
Grand Coulee
Banks Lake
Lake Chelan
Chelan
Wenatchee R.
Wells
Rocky Reach
Rock Island
Wanapum
Priest Rapids
WA
Nisqually R.
La Grande
McKenna
Alder
Packwood
Wynoochee
Mossyrock
Cowlitz R.
Chehalis R.
Mayfield
Toutle R.
SRS
Swift
Yale
Merwin
Skookumchuck
Castle Rock
Lewis R.
Columbia R.
Vancouver
Keechelus
Kachess
Cle Elum
Yakima R.
Naches R.
Roza
Kiona
Bumping Lake
White Salmon R.
Chandler
Tieton
Bonneville
John Day
McNary
Ice Harbor
Lower Monumental
Little Goose
Lower Granite
Snake R.
Walla Walla R.
Mill Creek
Washington
Oregon
Idaho
Spalding
Dworshak
N. Fork
Clearwater R.
Orofino
MT
Anatone
Lime Point (site)
White Bird
Salmon R.
Grande Ronde R.
Hells Canyon
Oxbow
Brownlee
Portland
Scoggins
Farmington
Tualatin R.
Johnson Cr.
Sandy R.
Hood R.
The Dalles
Deschutes
John Day
Willow Cr.
Umatilla R.
Willow Creek
McKay
Faraday
North Fork
Oak Grove
Timothy
Pelton
Round Butte
Clackamas R.
Yamhill R.
Luckiamute R.
Salem
Santiam R.
Ochoco
Prineville
Jefferson
Mehama
S. Santiam
N. Santiam
Detroit
Marys R.
Albany
Big Cliff
Yaquina R.
Harrisburg
Waterloo
Mid Santiam
Green Peter
Leaburg
Foster
Vida
McKenzie R.
Blue River
Carmen-Smith
Long Tom R.
Jasper
Fall Creek
Cougar
Monroe
Goshen
Dexter
Siuslaw R.
Fern Ridge
Lookout Point
Row R.
M. F. Willamette R.
Cottage Grove
Dorena
Umpqua R.
Cow Cr.
Galesville
Coast Fk.
Elk Cr.
North Fork
Middle Fork
Hills Creek
Rogue R.
Agness
Grants Pass
Lost Creek
Bear Cr.
Applegate R.
Emigrant
Howard Prairie
Applegate
Thief Valley
Powder R.
Weiser R.
Bully Creek
Willow Cr.
Snake R.
Agency Valley
Payette R.
Malheur R.
Emmett
Black Canyon
Cascade
Deadwood
Warm Springs
Owyhee
Owyhee R.
Boise R.
Boise
Lucky Peak
Arrowrock
Anderson Ranch
Big Wood R.
Magic
Swan Falls
C.J. Strike
Milner
Minidoka
American Falls
Henrys Lake
Island Park
Rexburg
Heise
Palisades
Jackson Lake
Montana
Wyoming
Snake R.
Portneuf R.
Blackfoot R.
Willow Cr.
Ririe
Blackfoot
Oregon
Idaho
Wyoming
ID
WY
OR
Storage
Corps
Bureau of Reclamation
Other
Run of River
Corps
Bureau of Reclamation
Other
Gage

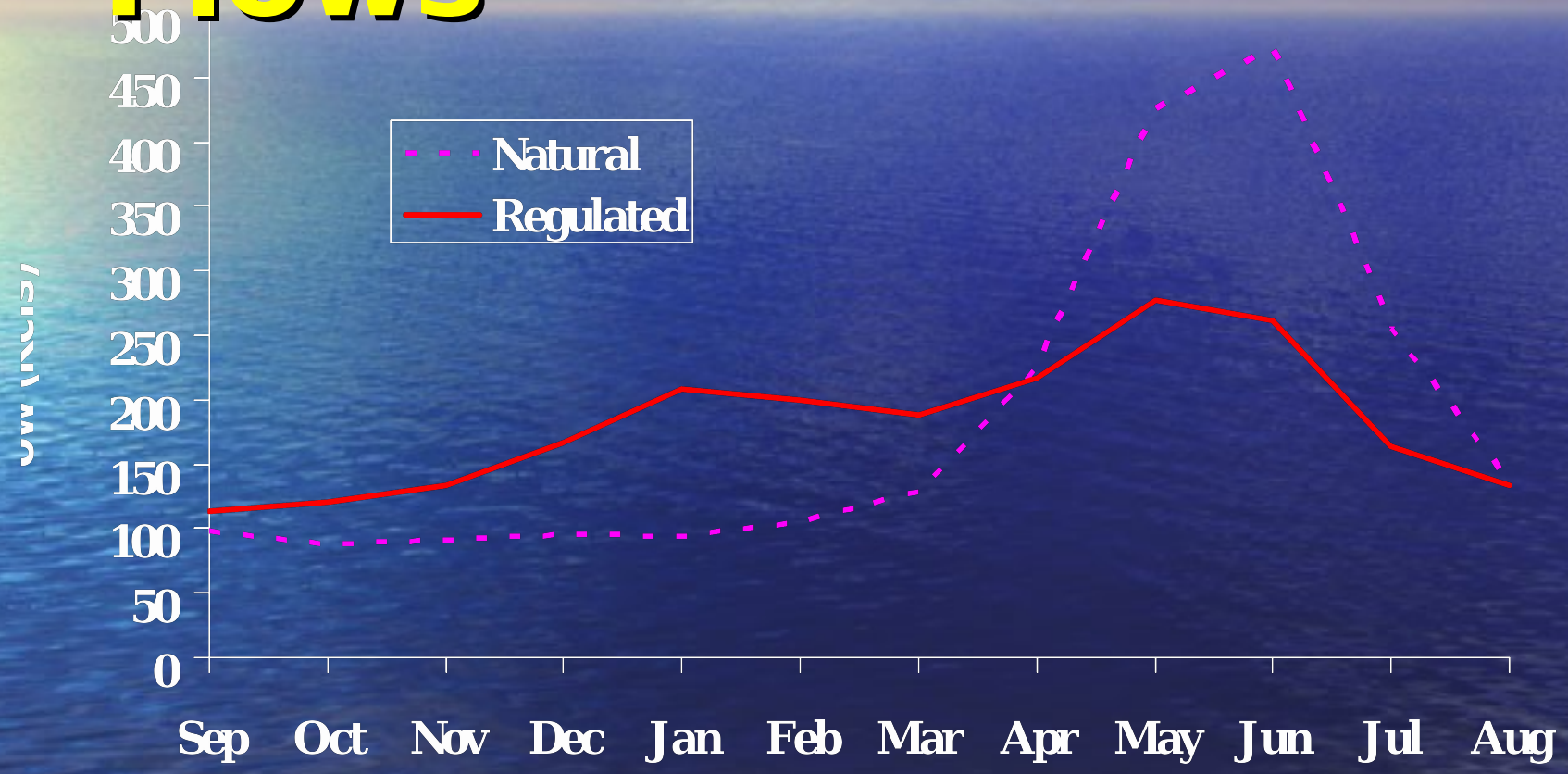
COLUMBIA RIVER SYSTEM HYDRO PLANT ELEVATIONS



AVERAGE ANNUAL RUNOFF AND USABLE RESERVOIR STORAGE IN MAJOR WESTERN RIVER BASINS



Natural & Regulated Flows



Characteristics

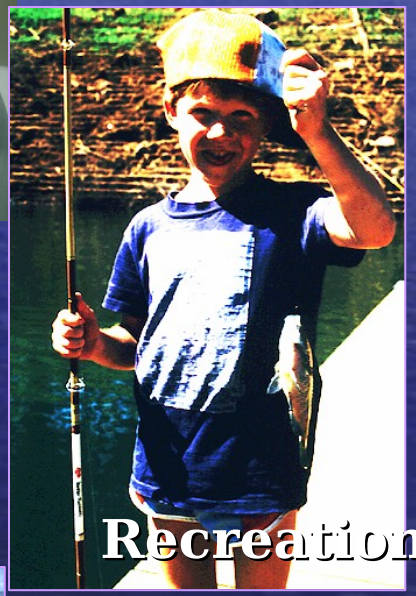
- 4th Largest river in North America
- Most powerful (35,000 MW total capacity)
- Drainage area = 259,000 mi^2 (669,500 km^2)
  219,000 (84% in 7 US states) + 39,500 (Canada)
- Source in British Columbia, Canada; L= 1,214 mi. (1,950 km)
- Major Sub-basins: Kootenay, Pend d'Oreille; Snake; Willamette
- Climate: winter (wet, mild); summer (dry, warm)
- Precip: 6 – 180" (1500 – 4600 mm); max. in winter
- Snow: 400" (10,000 mm) in fall - early spring
- Evaporation: 35 – 55" (900-1,400mm)
- Runoff and Streamflow:
  - Eastern Basin = snow; Western = rain)
  - Discharge: Avg 275 kcfs (7,787 m3/s); Vol.: 198 maf (244 km3)
  - Highest recorded flow: (1894): 1,240 kfs (35,113 m3/s)

Columbia River Basin
Comparison of space available for system flood control storage
Indicates total flood control space available, in million acre-feet
Mica
4
Duncan
1.3
Arrow
3
Grand Coulee
5
Libby
5
3.2
Hungry Horse
WA
MT
Columbia R.
Seattle
Snake R.
2
Dworshak
Portland
Brownlee
1
OR
Willamette R.
Jackson Lake
ID
Snake R.
Total space available for flood control: 24.5 MAF
Total active storage: 45 MAF

Operational Considerations

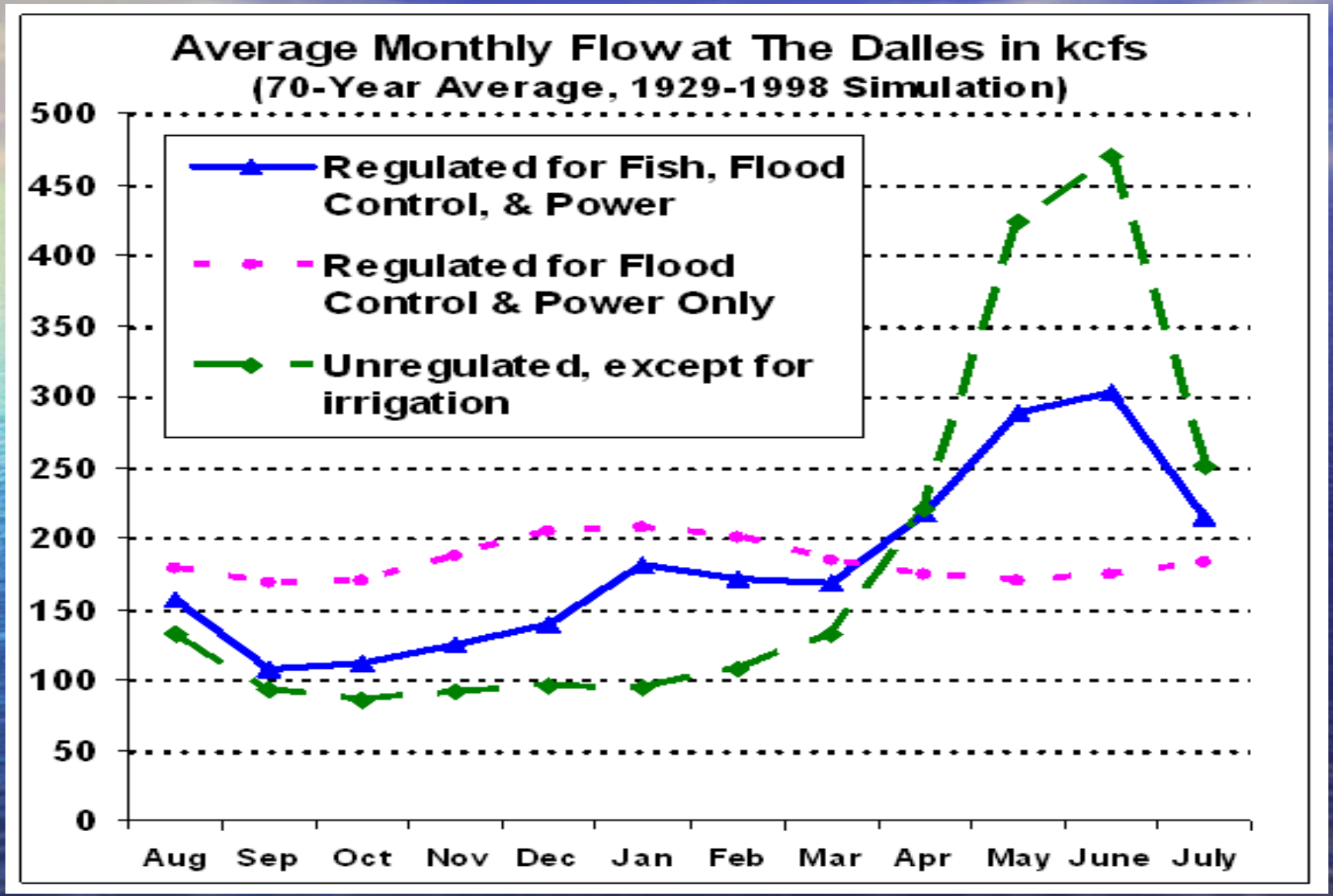
- Projects within basin are operated as a system to meet regional needs for hydropower, flood risk management, etc.
- System is operated for multiple purposes that can conflict with each other
  - Ex. Flood risk management requires lower reservoirs in winter and spring to store flood waters; fisheries requires reservoirs to be higher
- Environmental and fisheries requirements have increased significantly in recent years due to Endangered Species Act, Clean Water Act, and other factors.
- Infrastructure within the system is aging (average age is about 35 years), budget for improvements is constrained (spillways

Multiple Purposes

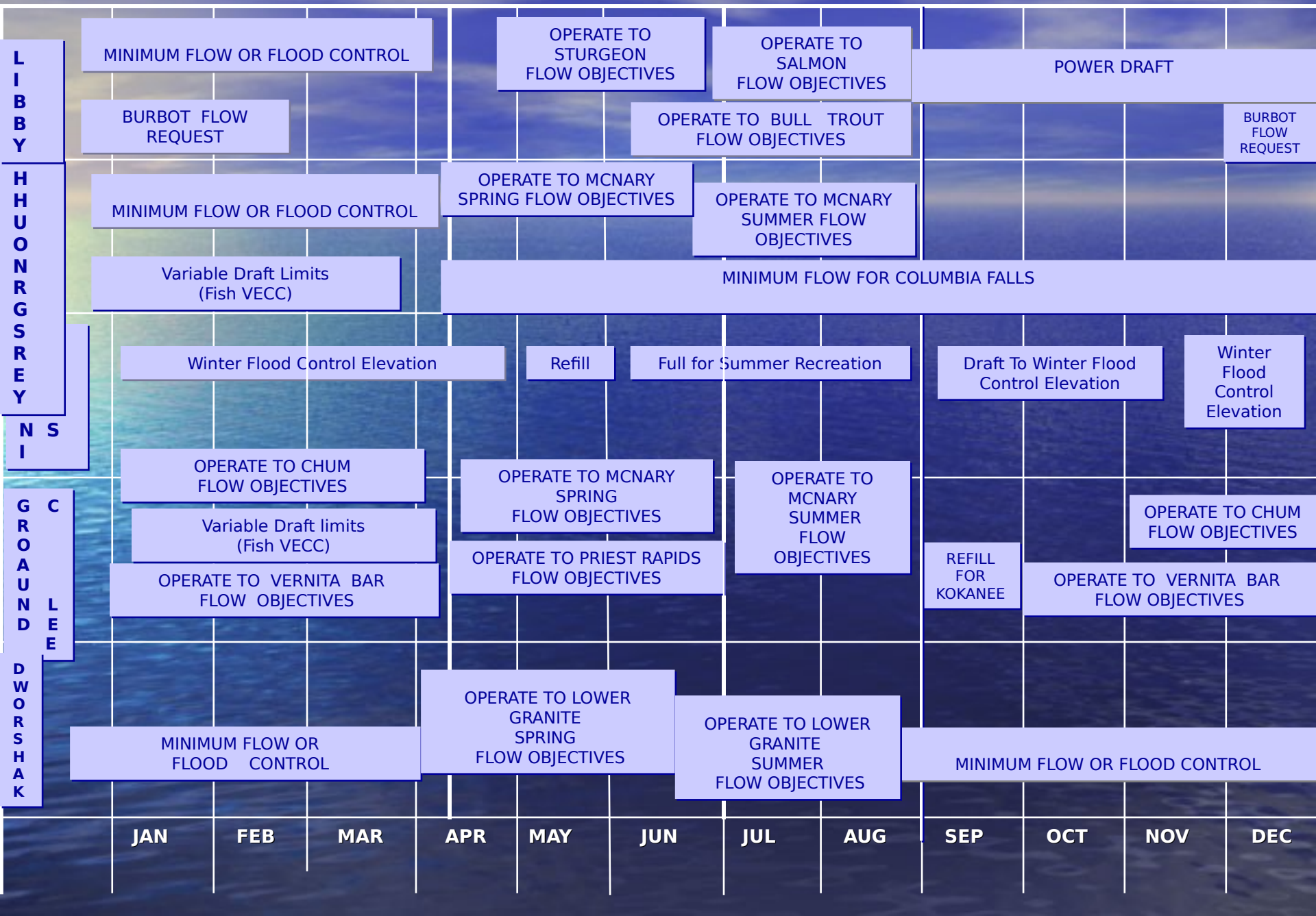


Endangered Species Act Operation

River Flows for Multi Purpose Operations Scenarios



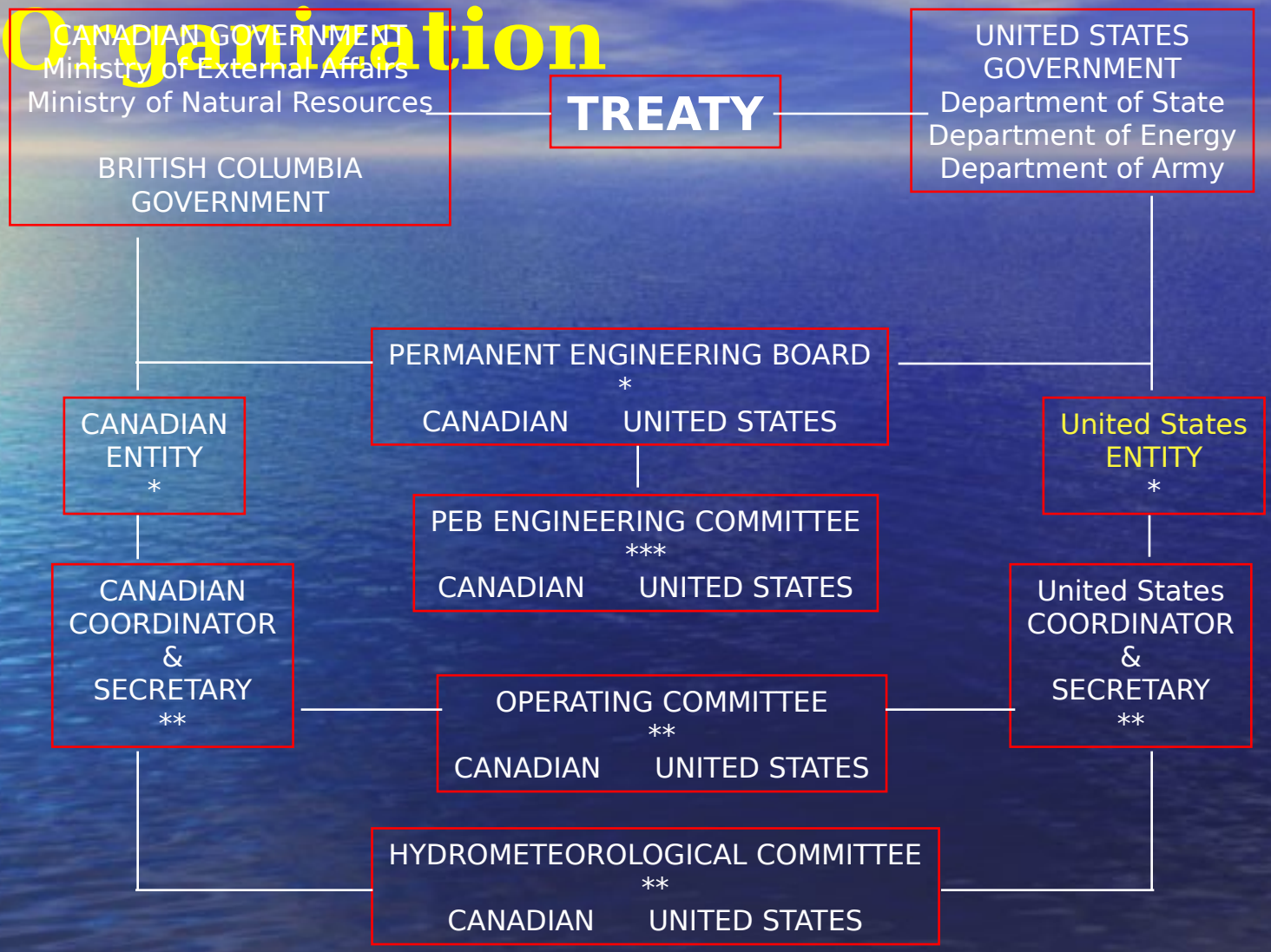
OPERATIONS TIMELINE



Coordination

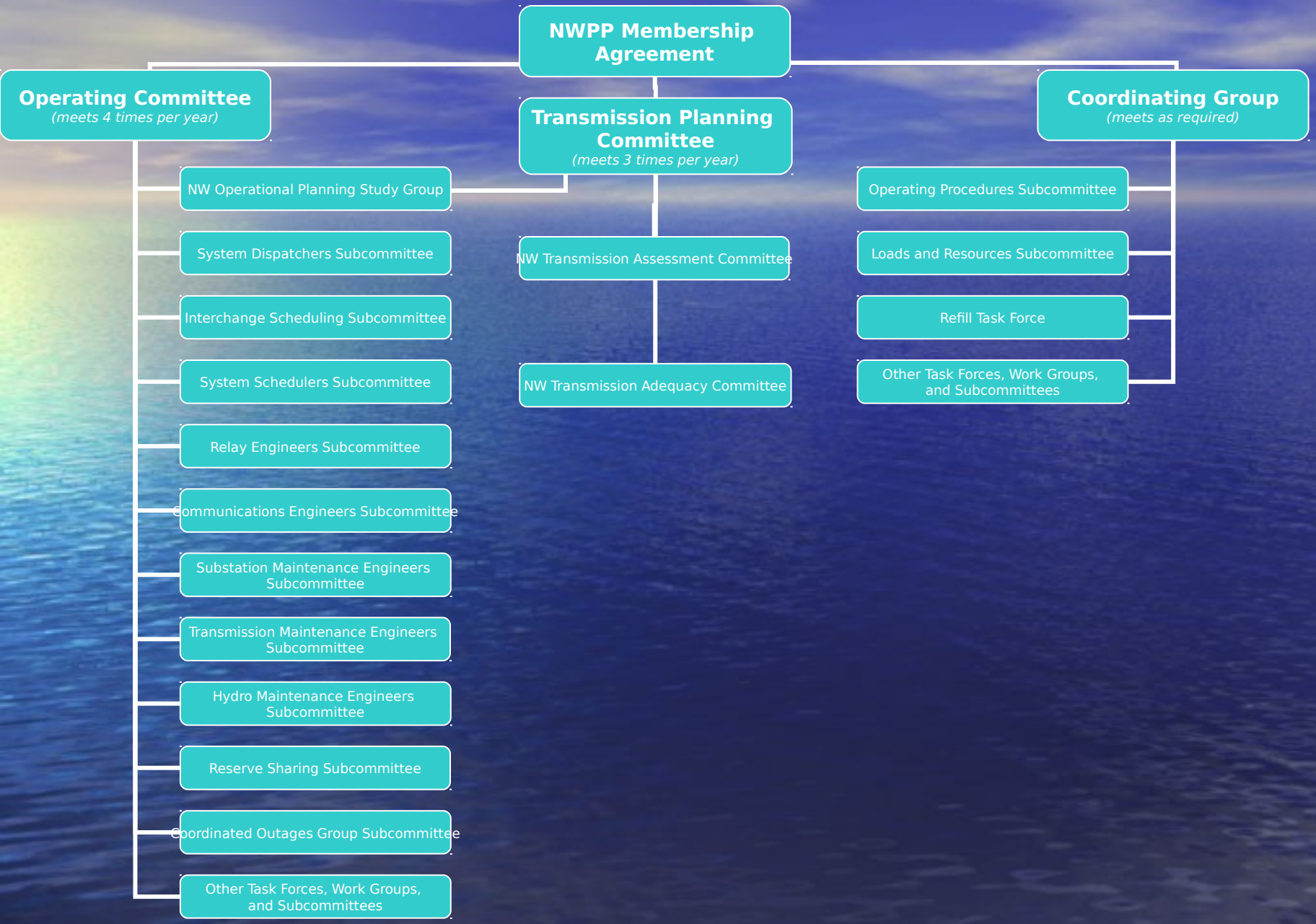
- Integrated water resource management approach used in coordinating system planning and operation
- Extensive coordination required to plan and operate system given multiple purposes, objectives, and interested parties (two countries, multiple states)
- Examples of coordination groups:
  - Columbia River Treaty
  - Pacific Northwest Coordination Agreement
  - Technical Management Team

Columbia River Treaty Organization

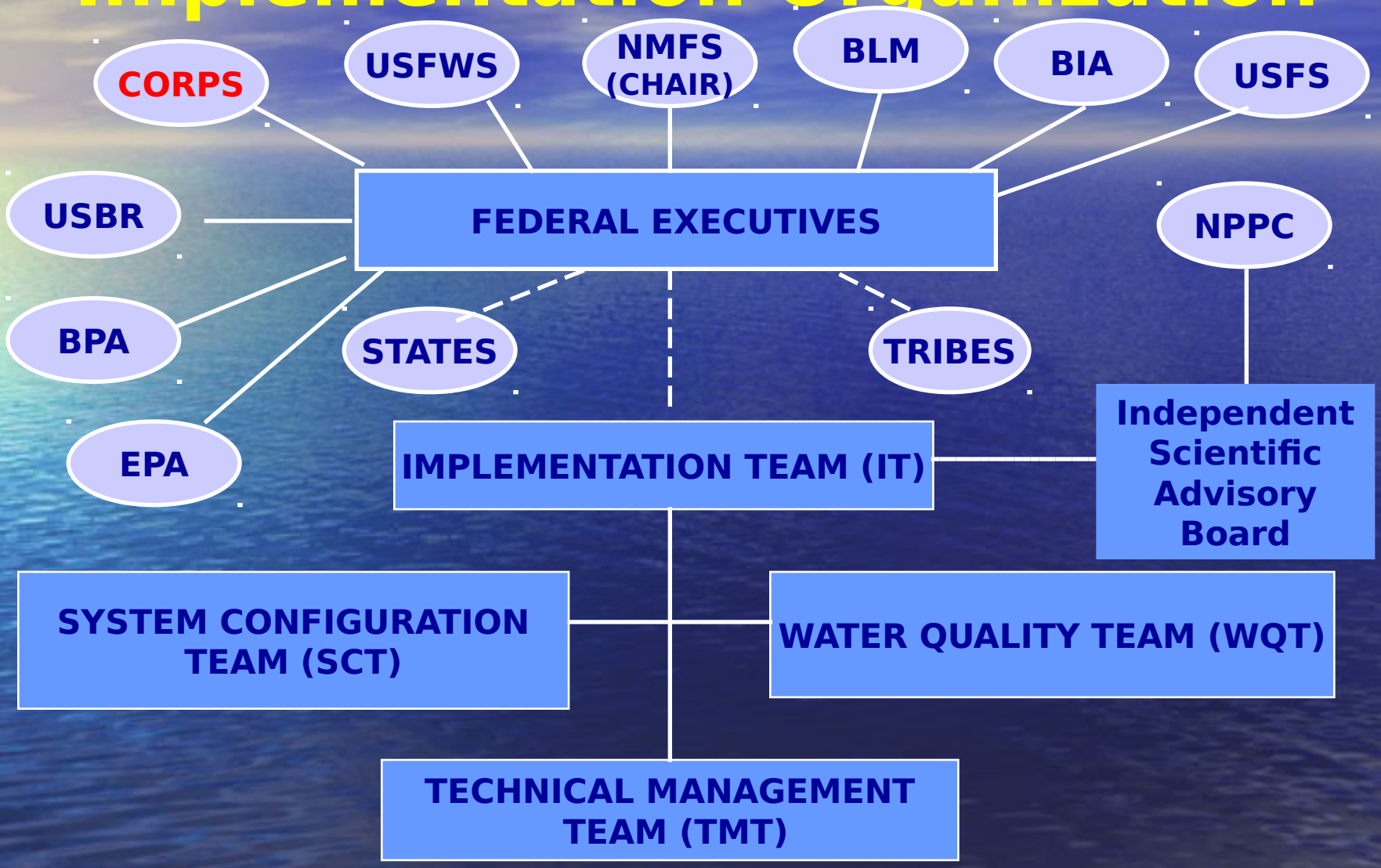


* Established by TREATY ** Established by ENTITY *** Established by PEB

Pacific Northwest Coordination Agreement – Northwest Power Pool

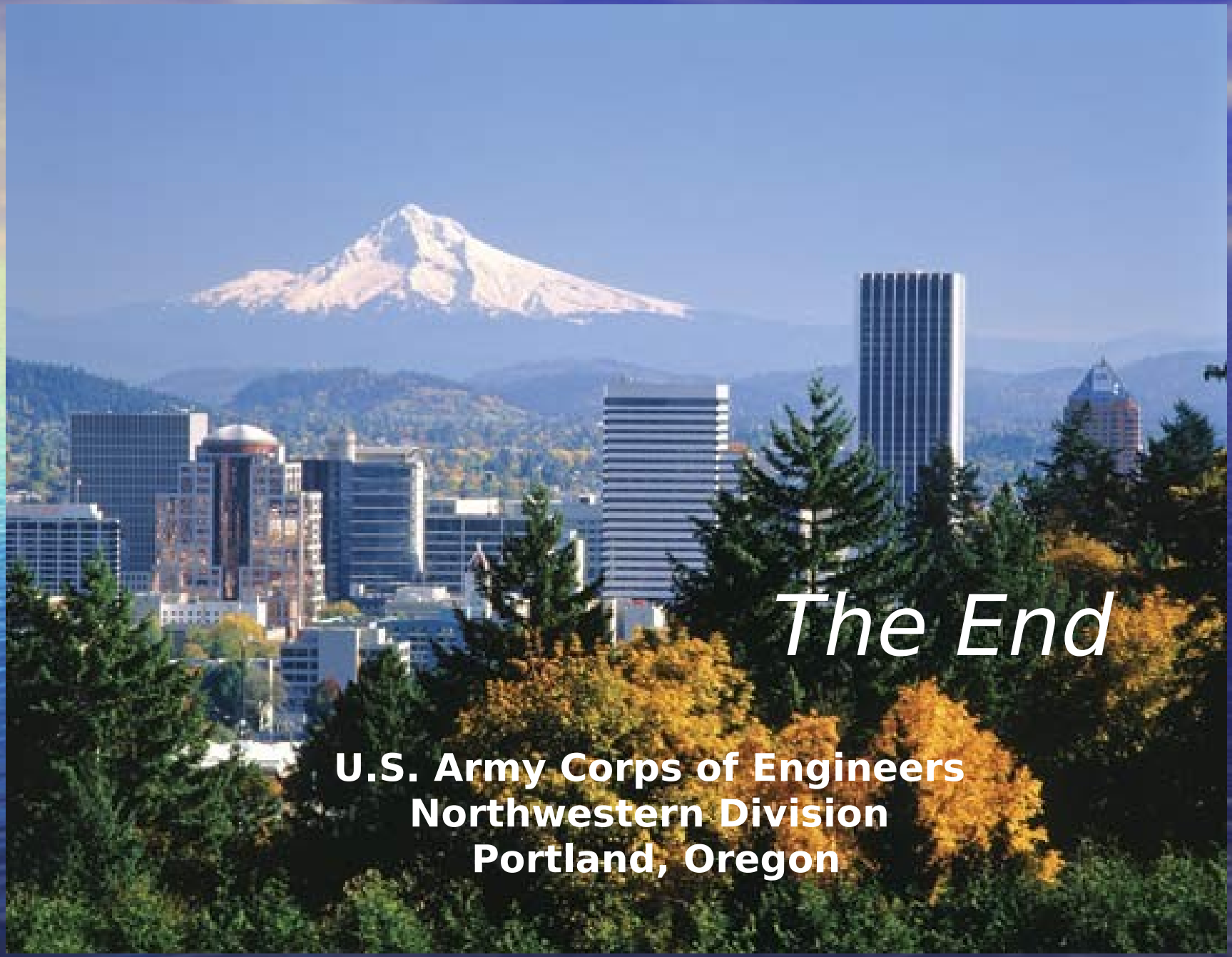


Regional Fisheries Implementation Organization



Summary

- Columbia River is a very important resource in the regional in terms of economic development, environmental sustainability, and other areas.
- Columbia River is operated as a system to meet multiple purposes
- Operating requirements have become more difficult to implement as increasing demands are being placed on the river
- Good coordination, communication, and working relations among the various parties involved are one of the major keys to success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U.S. Army Corps of Engineers
Northwestern Division
Portland, Oregon